CHAPTER 5

APPLICATION

5.1 INTRODUCTION

In the previous chapter, the generic model of inventive ideation has been integrated with a physico-mechanical systems model, which renders the resulting ideation model applicable to many engineering problems. This model was then used to establish, for each mechanism, the range of inventive ideas that could potentially be created by applying it to key attributes of such a system. Subsequently, the 40 Inventive Principles of TRIZ were analysed in terms of these mechanism-attribute pairs (referred to as Ideation Domains) and used to populate and further qualify the model.

So far, the work has satisfied three of the five objectives that were spelled out in Chapter 2. These are:

1) Provide insight into the mechanisms of inventive ideation, their use and relationships.
2) Produce an explicit framework that allows different ideation strategies to be followed.
3) Establish Ideation Domains, i.e. the various ways in which each mechanism can be applied to the range of physico-mechanical system attributes.

The above objectives represent the major focus of the research. However, it was also proposed that the model would be applied in practical situations to illustrate its value in

enhancing the capability of inventors and problem solvers in inventive ideation. This will be done by the following three applications, *viz*

1) Using the Ideation Domains to develop a simplified version of the Contradiction Matrix, in which the need to define problems in terms of their system contradictions is eliminated.
2) Auditing ideas that have been produced by brainstorming, and augmenting these by means of the model.
3) Provide a better measure of the real value offered by Random Stimulation, i.e. whether novel ideas can be created by following a structured approach rather than relying on 'off-the-wall' analogies and other input.

5.2 SIMPLIFIED VERSION OF THE CONTRADICTION MATRIX

Different strategies can be followed in developing a contradictionless matrix. One approach could be to use the *invention mechanisms* as the basis for identifying promising principles. This would for instance be done by identifying the mechanisms that underpin the principles that are used most frequently in improving a particular engineering parameter. Although the mechanisms would be simple to apply (since in the case of the 40 IPs there are only five of these) and provide at least some degree of guidance to the inventor as they would be parameter-specific, they would lack the necessary conceptual resolution that is provided by the relevant attributes. In some cases, especially using the Adjust mechanism, the inventor might therefore have to try out a fairly large number of possible attributes (and hence, principles) before hitting on a useful one.

An alternative option would be to utilise the, say, four *Ideation Domains* that are most prominent in improving each parameter. However, the fact that this will provide the greatest resolution means that the success rate could be expected to be relatively low, in the same region or perhaps only slightly better than that of the CM.

A third option would be to focus on the, say, four *attributes* that underpin the most frequently used principles. An advantage of such an approach is that it would strike a good balance

between the number of possible options that have to be considered and the efficiency of problem solving. **Table 5.1** presents a first attempt in this direction, called the 4-Attribute Matrix (4-AM). As shown in **Appendix 3**, this matrix was derived by applying the classification of IPs according to Table 4.2 to the frequency with which particulr IPs are used in the classic CM to improve an engineering parameter. This in effect represents a different version of the Contradictionless Matrix (CLM) of Liu & Chen (2001), based not on the frequency of individual IPs that are associated with each parameter, but on the attributes that link them. Being a contradictionless matrix, the 4-AM guides the inventor only according to the parameter to be improved, and not the deteriorating parameter as well.

The 4-AM was subsequently applied to a random selection of 40 mechanical engineering patents, extracted from the list compiled by Mann (2002) for assessing the efficiency of the classic CM. In each case, **Table 5.1** was used to determine, for the parameter to be improved, the four system attributes that could most likely solve the particular problem. For example, in the first patent in **Table 5.2** (no. 4966257), the parameter to be improved was identified as #10 (Force). The inventor would use this information to identify, from Table 5.1, the four attributes that could most likely yield a solution. In this particular example, in order of priority, these were Properties, Object, Frequency and Action. A solution to the problem is found in Move Object (IP15A and 15B), i.e. allowing relative movement between objects or their parts to find the best operational position or condition.

As shown in **Table 5.2**, applying the 4-AM to the 40 patents produced an overall success rate of 79%, defined as the number of IPs used by the inventors and also suggested by Table 5.2, as a fraction of the total number of IPs (i.e. 69) used by the inventors. This figure compared favourably with the 54% achieved by the classic CM for the same suite of examples.

Collectively, the four attributes cover a wider range of (sub)principles than the classic CM, which, for each contradiction, lists only up to four principles. It could therefore be argued as only logical that the likelihood of a successful match would be higher. However, it should be recognised that the attributes and the inventive principles are similar conceptual entities and thus can be considered equal in terms of their application. It may reasonably be assumed that

Table 5.1. The 4-Attribute Matrix: Attributes most likely to satisfy the engineering parameter to be improved.

Parameter to be Improved	Attributes			
1. Weight: moving object	Properties	Object	Environment	Concentration
2. Weight: binding object	Properties	Object	Action	Duration
3. Length: moving object	Object	Properties	Symmetry	Action
4. Length: binding object	Properties	Object	Curvilinearity	Frequency
5. Area: moving object	Object	Dimension	Action	Properties
6. Area: binding object	Frequency	Properties	Concentration	Dimension
7. Volume: moving object	Properties	Object	Symmetry	Function
8. Volume: binding object	Properties	Object	Frequency	Curvilinearity
9. Speed	Object	Properties	Action	Concentration
10. Force	Properties	Object	Frequency	Action
11. Tension, pressure	Properties	Object	Curvilinearity	Action
12. Shape	Object	Action	Curvilinearity	Properties
13. Stability of object	Properties	Object	Material	Action
14. Strength	Object	Material	Curvilinearity	Duration
15. Durability: moving object	Properties	Frequency	Object	Duration
16. Durability: binding object	Quantity	Material	Object	Concentration
17. Temperature	Properties	Action	Object	Concentration
18. Brightness	Action	Sensory	Object	Properties
19. Energy spent: moving object	Properties	Action	Frequency	Object
20. Energy spent: binding object	Object	Properties	Action	Frequency
21. Power	Properties	Frequency	Object	Sensory
22. Waste of energy	Properties	Object	Action	Frequency
23. Waste of substance	Object	Properties	Frequency	Duration
24. Loss of information	Object	Properties	Environment	Sensory
25. Waste of time	Properties	Object	Frequency	Symmetry
26. Amount of substance	Material	Object	Frequency	Curvilinearity
27. Reliability	Properties	Object	Action	Duration
28. Accuracy of measurement	Sensory	Object	Function	Action
29. Accuracy of manufacturing	Sensory	Object	Frequency	Properties
30. Harmful factors on object	Environment	Material	Object	Action
31. Harmful side effects	Material	Environment	Object	Concentration
32. Manufacturability	Object	Properties	Action	Quantity
33. Convenience of use	Object	Action	Properties	Sensory
34. Repairability	Object	Properties	Action	Sensory
35. Adaptability	Properties	Object	Quantity	Action
36. Complexity of system	Object	Action	Properties	Duration
37. Complexity of control	Properties	Object	Duration	Action
38. Level of automation	Properties	Object	Action	Frequency
39. Productivity	Properties	Object	Environment	Frequency
Version 1.0				

Table 5.2. Analysis of patents in terms of system contradictions.

Ex. no.	Patent no. [1]	Contradiction [2]	Inventor used [3]	CM suggested	CM score [4]	4-AM includes	4-AM score
1	4966257	10, 05	15	19, 10, 15	1	15	1
2	5485307	35, 12	01	15, 37, 01, 08	1	01	1
3	5485359	18, 19	25	32, 01, 19	0	-	0
4	5493580	23, 22	01, 35, 31	35, 27, 02, 31	2	01, 35, 31	3
5	5543179	30, 14	16, 10, 01	35, 18, 37, 01	1	10, 01	2
6	5568961	14, 01	01, 15	01, 08, 15, 40	2	01, 15	2
7	5569009	27, 36	01	13, 35, 01	1	01	1
8	5680467	28, 13	32, 25, 13	32, 35, 13	2	32, 35, 13	3
9	5694827	15, 09	03, 35, 05	03, 35, 05	3	03, 35, 05	3
10	GB2312704	01, 30	22	22, 21, 27, 39	1	22	1
11	GB2315973	23, 17	31	21, 36, 39, 31	1	31	1
12	GB2315980	12, 08	02, 35	07, 02, 35	2	02, 35	2
13	GB2315994	26, 07	25	15, 20, 29	0	-	0
14	GB2316044	10, 33	01, 15	01, 28, 03, 25	1	01, 15	2
15	GB2350145	33, 35	15, 01	15, 34, 01, 16	2	15, 01	2
16	GB2350268	24, 27	10	10, 28, 23	1	10	1
17	WO01/13760	07, 05	17, 04	01, 07, 04, 17	2	-, 04	1
18	WO01/70445	28, 03	05, 26	05, 16, 26, 28	2	05, 26	2
19	5746360	07, 31	02, 30	17, 02, 40, 01	1	02, -	1
20	5992588	10, 03	17	17, 19, 09, 36	1	-	0
21	6099658	09, 31	24	02, 24, 35, 21	1	24	1
22	6299550	03, 09	13	13, 04, 08	1	13	1
23	6272687	14, 33	03, 40, 15	32, 40, 25, 02	1	03, 15, 40	3
24	GB2307485	15,10	04, 18	02, 16, 19	0	18	1
25	6296160	31, 36	08, 05	19, 01, 31	0	05, 08	2
26	5493551	33, 36	17	32, 26, 12, 17	1	-	0
27	6293565	09, 31	17, 14, 03	02, 21, 24, 35	0	03, 14, -	2
28	GB2309876	36, 30	02	22, 19, 29, 40	0	02	1
29	5999869	31,15	23	15, 22, 33, 31	0	-	0
30	5651055	33, 24	10, 28	04, 10, 27, 22	1	10, 28	2
31	5650990	10, 13	15	35, 10, 21	0	15	1
32	5650983	02, 24	05	10, 15, 35	0	05	1
33	5543179	37, 18	32, 23	02, 24, 26	0	23	1
34	6220333	24, 27	17, 28, 13	10, 28, 23	1	-, 28, -	1
35	GB2303376	13, 26	35, 24	15, 32, 35	1	35, 24	2
36	6176374	11, 14	09, 03	09, 18, 03, 40	2	09, 03	2
37	6065555	19, 22	23	12, 22, 15, 24	0	23	1
38	5824184	33, 03	03	01, 17, 13, 12	0	03	1
39	6099018	31, 12	01, 17	35, 01	1	01, -	1
40	6098208	05, 01	14, 30	02, 17, 29, 04	0	14, 30	2
Total			**69**		**37**		**55**
%			**100**		**54**		**79**

[1] From the list of Mann (2002).
[2] Contradictions are presented in the format: Parameter to be improved, deteriorating (worsening) parameter.
[3] According to the analysis by Mann (2002).
[4] The score is determined as the number of principles suggested by each tool, that matches the inventive principles used by the inventor.

an inventor would have a similar task scanning (in a worst case such as the Object attribute) four IDs for solutions than considering for instance the same number of sub-sections of an inventive principle (e.g. IP17 - Another dimension). The higher success rate of the attributes should therefore not be attributed solely to the increased number of principles that are covered, but also to the grouping of similar principles, which in this case is based on clear criteria.

The '4-AM includes' column of Table 5.2 also shows the cases in which it was unable to predict the IP used in the particular patent. As is clear from the Table, these constituted mainly two system attributes, namely Dimension (IPs 17 and 30) and Function (IP25). If these attributes were for instance used as an alternative option in situations where the 4-attribute strategy was unsuccessful, the success rate for the suite of patents could be improved substantially.

5.2.1 Improvements

As mentioned earlier, Table 5.1 represents only the first version of the 4-AM, and scope therefore still exists for improvement. One such enhancement that has been effected since (Ross 2006b) was to provide better resolution around the Object and Action attributes. In most cases, each attribute involves at most two IDs, and thus the inventive options can be interpreted easily. For example, if the Sensory attribute was indicated as a possible source of inventive solutions, the inventor has a simple choice between (1) Changing the colour or transparency of the object or (2) Adding luminescent or other tracers to improve visibility. The Object and Action attributes, however, each involve four IDs, and thus the search process has been simplified by determining, for these attributes, the two mechanisms that in each case are most likely to solve the particular problem.

A further improvement to this first version of the simplified CM was to develop a unique graphic symbol for each ID. This effectively turns the CM and IPs into a visual tool, which

has been dubbed VizTRIZ (Ross 2006b). In addition to the fact that the number of principles have been reduced significantly, an advantage of the visual format is that it could enhance training of the tool as well as its user-friendliness.

The improved 4-AM tool was applied to a range of 60 physico-mechanical engineering patents (i.e. the original 40 in Table 5.2, plus an additional 20 that were also obtained from the list compiled by Mann (2002)). In order to assess its effectiveness against other similar tools, the classic (4-principle) Contradiction Matrix, the six inventive principles used most commonly in the CM (Top6) as well as the Contradictionless Matrix of Liu & Chen (2001) were applied to the same examples (Ross 2006b). In the case of the latter, in order to facilitate direct comparison with the Top6, the 6 IPs that are associated most frequently with each engineering parameter were used.

For the patents that were analysed, the inventors employed a total of 106 IPs. Of these, VizTRIZ, the Contradiction Matrix, Top6 and the Contradictionless Matrix were able to achieve success rates (effectiveness) of 79%, 51%, 41% and 32% respectively; i.e. using VizTRIZ, in approximately three quarters of the cases the inventor would have been able to reach the eventually patented solution (Ross, 2006b). The first two figures compare well with the results shown in Table 5.2.

5.3 IDEA AUDITING

A key premise of brainstorming is the notion to put quantity before quality, i.e. to produce as many ideas as possible. If run correctly, i.e. if people focus on building on the ideas of others and witholding judgement, this objective can normally be achieved. However, being largely an unstructured approach – the grouping of similar ideas normally happens only after the thinking session - there may be parts of the problem space that remain unexplored. The ideation model was therefore tested for its ability to analyse the outcome of a brainstorm and, on the basis of this, identify areas where additional thinking could prove useful.

By ways of illustration, a simple case study '*How to dispose of 1 billion paperclips profitably*' was used. **Table 5.3** shows the ideas that were generated in the brainstorming (Majaro 1992), as well as an analysis, as per the ideation model, of the mechanisms and attributes that were involved. **Table 5.4** presents the additional ideas that have been generated from the analysis.

Table 5.3 Case study: Analysis of ideas.

No.	"Use as ..."	Mechanism	Attribute	Based on:
	Mechanical cleaners			
1	Pilot light cleaners	Adjust	2-D shape [1)]	Physical property (bendable) & 1-D shape [1)]
2	Spark plug cleaners	Associate	Function	Idea #1
3	Pipe cleaners	"	"	"
4	Drain cleaners	"	"	"
	Physical cleaners			
6	Ear cleaners	Associate	Function	Ideas #1 to 4
7	Nose cleaners		"	
8	Tooth picks		"	
9	Back-scratchers		" (and Shape)	
10	Belly button		"	
11	Nail cleaners		"	
	Toys			
	Magnetised toy	Add	Properties & Colour	
	Desk display			
12	Coloured clips	Associate	Colour & Function	
13	Urgency sign	Associate	Colour	Idea #12
14	Suction clips	Add	Function	Idea #12
	Jewellery			
15	Wedding rings	Adjust	2-D shape	1-D shape & physical property
16	Brooch	Add	Object	Shape & Size, associate with metal bracelets
17	Bracelet	Associate	Function	Idea #16
18	Banglets			
19	Buckles			
20	Necklaces			
21	Ear-nose rings		Shape	Idea #15
	Gifts			
22	Christmas gifts	Associate	Context	Toys
	Tokens			
23	Money	Associate	Action and Number	Idea #22
24	Luncheon vouchers		"	Idea #23
25	Poker tokens		"	"
	Games			
26	'Clippy winks'	Associate	Environment	Idea #12
27	National game	"	"	"
28	Painting set	"	Colour	Possible uses.
	Miscellaneous			

29	Homing device	Associate	Shape & Material	TV 'bunny ears'
30	Anti-stress activity	"	"	"
	Fashionable clothing			
31	G-string	Add	Object	2-D shape & size, associate with clothing
32	Dress studded with clips			
	Conference aids			
33	Name tags	Associate	Function	-
	Functional clothing			
34	Decorative caps	Add	Object	2-D shape & size, associate with clothing
35	Helmets	Associate	Function	Idea #34, 'wearable accessories'.
36	Veils			"
37	Money belts			"
38	Bras			"
39	Suits of armour			"
40	Flak jackets			"

[1] The term 1-D shape refers to the steel wire of which the clip is made, while 2-D shape refers to the shape of the clip itself.

Table 5.4 Additional ideas generated by use of the ideation model.

No.	Mechanism	Attribute	Based on:	Idea
41	Adjust	Size	Material & 1-D Shape	Make small bicycles, flagpoles for food, bristles for steel brushes etc.
42		1-D shape	Property (resistivity)	Make 'cultured pearls' (3-D, by melting with high voltage), use in jewellery.
43	Associate	Lustre (shiny)	Traffic / clothing	Use as reflectors or fashion accessories.
		Material & 1-D shape		Use to stitch, weave or sew. Use as ring binders, or clips / hooks for photo film / X-rays, fishing hooks, xylophone needles etc. Pin cushion for sticking on things
44		Property (conductivity)		Use as electrical fuses.
45		Property (resilience)		Use as small springs.
46		2-D shape		Use as a miniature race-track (e.g. for ants)
47	Add	Object	Shape & Colour	Use as Christmas decorations, bottle jackets
48	Other Use	Object	Cost of Material	Sell as scrap metal.
49			Colour & Shape	Use to makes pictures or signs.

5.4 'LOGICAL DESIGN' vs 'OFF-THE-WALL'

In Chapter 2, the issue was raised of whether Random stimulation really offers the prospect, as is claimed, of producing ideas that would not have been able to be generated in a more

structured manner. The question was to what extent a systematic design process, such as was followed by mapping the generic mechanisms of inventive ideation against the attributes of a simple model, could have produced similar or the same outcomes directly. In Section 4.6, a brief analysis was made of the mechanism of Random stimulation and how it relates to using (direct) Association. From this analysis, it was concluded that in situations where the key attributes of the problem could be readily identified, a combination of the Reversal and Association mechanisms may yield the same results directly and with a higher chance of success. This would apply especially to open-ended problems where there are a large number of options that can be explored.

In order to test the ideation model and the above hypothesis, a number of examples were sourced from the creativity literature. These included Random stimulation, provocation and other techniques.

Example 1 - Random stimulation

The example presented in Chapter 2 used the Random analogy of a 'traffic light' to generate ideas that could be used for cigarettes. The idea was to print a red band close to the butt end of the cigarette, indicating where it becomes (even more) dangerous to smoke further.

As stated above, in a situation like this it is suggested that Association could be used efficiently. For this problem, the Action of 'lighting and extinguishing' a cigarette is chosen. Moving out into the association funnel, similar paired opposites such as 'starting and stopping, birth and death, on and off, opening and closing' would be produced. Applying Association to establish concepts that fall within this funnel (*What else can be thought of that starts and/or stops things?)* would have led directly, amongst several other concepts, to 'traffic light'. The strong relationship between the Action (stopping) and the Colour (red) would have led directly to the idea of a red band around the cigarette.

Several other concepts and useful ideas can be generated from the same 'starting and stopping' focus, including:

- Fire extinguisher (the cigarette extinguishes itself)
- Brake pedals (squeezing the cigarette to allow through an adjustable amount of air)
- Speedometer (have a line printed along the length of the cigarette which changes from green to yellow to red to black)
- Timer switch (automatic starting and stopping of some sort, allow cigarette to burn only for certain intervals).

As stated in the hypothesis, an undesired or harmful factor could be turned first into a positive factor by Reversal, and followed by Association to produce matching concepts. In this case, focusing on the undesired feature of the smoke burning the smoker's throat:

Reverse Action (burning) = cooling - Associate = water - Associate : dilute. This creates the idea of diluting the smoke, e.g. having perforations that would allow through more air.

Example 2 - Random stimulation

Another example of Random Stimulation, *Office copier* po *nose*, is presented by DeBono (1993). The term 'po' is a short way of indicating 'hy(po)thesis, sup(po)se' or '(p)rovocation (o)peration'. [According to De Bono (1993), the word 'could not exist in any language... it is a non-language word.' The Oxford English Dictionary however gives the meaning as 'chamber pot' ;-)]

The idea produced from this stimulation was to replace the traditional visual warning signal (e.g. a red light) with a particular type of smell. This would be done for instance by a cartridge that releases a certain smell to indicate a particular type of problem with the copier.

Using the ID of Adjust Sensory attribute, i.e. "If one sensory attribute is used for a particular function, complement by, or switch to, another; if none are used, introduce a new one") would have led directly to the idea of having smell, sound or perhaps even taste introduced as a new feature.

Example 3 - Random stimulation

The novel provocation *Cigarette* po *Flower* is another example of Random stimulation (De Bono 1993), leading to the idea of putting seeds in the butt of a cigarette, so that flowers will grow (at least theoretically) where the butts are discarded by inconsiderate smokers.

If the problem is for instance posed as '*Find ways to reduce the litter caused by discarding cigarette butts*' (i.e. overcoming an undesired factor), the analysis of Section 4.6 suggests combining the mechanisms of Reversal and Association. Reversal of this undesired factor leads to the concept of something smelling and/or looking good. Associating it with the Environment in which cigarette butts are found (e.g. pavements, flower beds), gives the idea of turning the butts into flowers, trees or compost, e.g. by inserting seeds into the butts.

Example 4 - Reversal

The statement '*I have orange juice for breakfast*' is reversed as the provocation '*Orange juice has me for breakfast*' (De Bono 1993). This led to the idea to have a cartridge in a shower head that scents the water.

Applying the ID of Associate Environment to the problem statement '*Find new ideas for showers*' leads to things such as a basin, bath, soap, shampoo and deodorants. The concept of bath salts that scent the water would have led to the same idea of a scented shower. Alternatively, Adjusting Sensory attributes as in Example 2 would have produced the same outcome directly.

Other ideas that can be generated include for instance:

Associate Action (water falling) leads to 'waterfall', 'rain' etc. Picking 'waterfall', and focusing on Shape, leads to the idea of shower heads in the shape of famous waterfalls (Niagara,

Victoria etc.), naming the range after the particular falls. Focusing on Action, *viz* a strong flow and mist spray, leads to the idea of adjustable sprays at different levels of the shower.

Associate Size (and/or) Shape leads to the concept of a 'telephone booth'. Ideas stemming from this include a telephone shower head, dialing the water temperature, public shower booths, waterproof telephones and so on.

Example 5 - Morphological synthesis

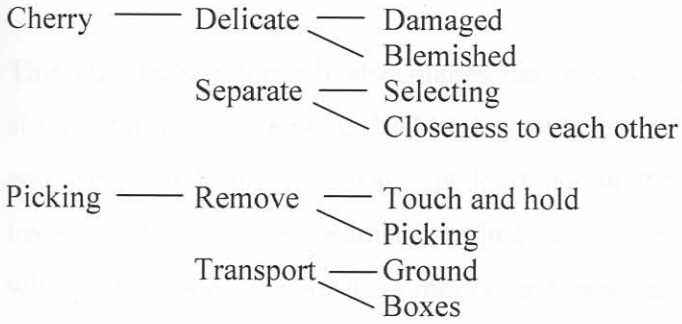
Morphological synthesis was used to find a solution to the problem "*Improve the design of laundry hampers*" (Michalko 1991: 119).

Direct Association of the Action of throwing dirty laundry into a bin (*Where else do people pass (throw / kick / pull / hit) things into a receptacle ?*) leads to concepts such as rubbish bins, basket ball nets, clothes donation bins, soccer nets, tennis courts, etc. Matching this with the preferences of young kids would produce the idea of a hamper in the form of a basket ball net, located for example behind a bedroom or bathroom door.

Example 6 - Attribute splitting

In Chapter 3, the following example was used to explain how the mechanisms of inventive ideation were identified; for ease of reference, it is repeated here.

A farmer requires new methods to harvest cherries (Michalko 1991: 60). The two keywords for this open-ended problem were chosen as 'cherry' (noun) and 'picking' (verb). Selecting one attribute, for example 'delicate', gives the idea to create a new type of cherry with stronger skin, to better withstand handling. Re-assembling 'blemished', 'closeness' and 'transport', one might look for a way of satisfying these three attributes. Another idea may be to shake the tree and catch the cherries in nets to minimise bruising.



By means of illustration, applying the ID of Re-move Object leads to the same and other additional ideas:

- Movement of Object (easily derived from 'pick cherry') suggests, amongst others, limiting (the need for) movement or position changes. This leads to the concept of something that would be either able to remove the cherries *in situ*, or minimise their drop height.
- Remove Object in time, i.e. 'Discard, disperse or dissolve things that have fulfilled their functions', leads for instance to the idea of a cherry harvesting itself, e.g. engineered such that the stem deteriorates and detaches when the cherry is ripe.
- Remove Object in space suggests that the cherries are separated from the environment by covering them in something that would allow easy and gentle removal.

Associations with the Action of cherries dropping from a tree, leads to concepts such as using a type of safety net or mattress to catch them, or a safety harness of some sort to prevent them from falling.

5.5 SUMMARY

The few examples presented above, by way of illustration, suggest that the ideation model is capable of producing a variety of ideas in a systematic fashion, including some that are claimed to be the unique outcome of Random stimulation. Furthermore, rather than elaborate

techniques or provocations, these ideas were created in a simple and direct fashion, based on easily identifiable attributes.

This structured approach also makes the process of provocation more acceptable - people simply don't sit in creative thinking sessions and offer statements such as "Po, Elvis is alive and well and living in Texas" (at least not in the sessions in which the author has been involved in to date ;-)). Rather than just asking participants to state provocations 'boldly and without thinking', the ideation model, and especially the range of IDs based on the Adjust mechanism, provides guidelines to do it systematically and effectively. As Goldenberg *et al.* (1999a) point out, 'a number of researchers indicated that ... techniques that promote total freedom – no directional guidance, constraints, criticism or thinking within bounded scope – are not effective, and that the performance of problem solvers instructed to 'break the rules, get out of the square, and change paradigms', was not better than that of individuals who were not given any instructions at all. Adherence to a cognitive frame of reference involves sensitivity to the 'rules of the game' and, by functioning within a frame, one achieves a better position from which to notice or recognise the unexpected'. Similarly, Scott *et al.* (2004: 377) highlight that successful creativity training courses devote less time and resources to techniques that stress unconstrained exploration; in their words, *'the use of techniques that stress analysis of novel, ill-defined problems contributes to success'*.

An important principle underlying creativity and the emergence of truly novel ideas is the fact that, very rarely, these are the result of a number of small tweaks that are re-arranged into some new format, as several of the creative thinking techniques advocate. As the innovation theory would have it, a large number of incremental steps do not add up to one step change. A novel idea has as its essence one feature that rises sharply above the threshold of normal or accepted practice; the rest follows (is drawn along) automatically, and naturally. A big bang is not created by a thousand pellet guns.